

REMARKS

Reconsideration of this application, in view of the foregoing amendment and the following remarks, is respectfully requested.

Claims 1-123 were originally presented for consideration in this application, and the Examiner's indication that Claims 24, 26-36, 38-49, 66, 67, 76-79, 83-85, 102, 107 and 108 contain patentable subject matter is noted with appreciation.

By the foregoing amendment, Claims 8, 16, 17 and 114 have been canceled without prejudice or disclaimer, and Claims 1, 6, 9, 10, 12-14, 19, 74, 81, 109 and 115 have been amended. Accordingly, Claims 1-7, 9-15, 18-113 and 115-123 remain in this application for consideration and allowance.

In his October 4, 2002 Office Action, the Examiner made the following objections and rejections which are respectfully traversed for reasons subsequently set forth herein:

1. The drawings have been objected to under 37 CFR §1.183(a) for failing to show the tubular membrane as recited in Claims 111 and 117, the membrane surrounded by the piezoelectric material as recited in Claims 115 and 117, the membrane surrounded by the piezoelectric material as recited in Claims 115 and 123, the membrane having fluid flowing therethrough as recited in Claim 118, and the cavity surrounding the membrane as recited in Claim 122;
2. The specification has been objected to under 37 CFR §1.75(d) and MPEP §608.01(o) as failing to provide proper antecedent basis for the fluid chamber as recited in Claim 50;
3. Claims 50-73, 111, 115, 117, 118, 122 and 123 stand rejected under 35 USC §112, first paragraph, as containing subject matter not adequately described in the specification - namely, the fluid chamber, the tubular membrane and the membrane surrounded by the piezoelectric material, the membrane having fluid flowing therethrough, and the membrane surrounded by the cavity;

4. Claims 1-8, 14-19, 50, 51, 53, 54, 57, 62, 64, 65, 68-70, 74, 75, 80-82, 86-99, 101 and 103-106 stand rejected under 35 USC §102(b) as being anticipated by U.S. Patent 3,970, 877 to Russell et al;

5. Claims 1-3 and 8 stand rejected under 35 USC §102(b) as being anticipated by U.S. Patent 4,467,236 to Kolm et al;

6. Claims 1-4, 7, 8, 14, 15, 18 and 19 stand rejected under 35 USC §102(b) as being anticipated by U.S. Patent 5,839,508 to Tubel et al;

7. Claims 23, 25, 37, 62, 63, 109, 110, 112-114, 116 and 119-121 stand rejected under 35 USC §102(b) as being anticipated by U.S. Patent 5,554,922 to Kunkel;

8. Claims 9-11, 20-22, 59-61 and 71-73 stand rejected under 35 USC §103(a) as being unpatentable over Russell et al or Tubel et al in view of U.S. Patent 4,669,068 to Klatt;

9. Claims 12 and 13 stand rejected under 35 USC §103(a) as being unpatentable over Russell et al or Kolm et al or Tubel et al; and

10. Claims 111 and 117 stand rejected under 35 USC §103(a) as being unpatentable over Kunkel.

1. THE 37 CFR §1.183(a) DRAWING OBJECTIONS

All of the recited claim features noted by the Examiner are clearly shown in applicants' drawings as originally filed. Specifically the tubular membrane recited in Claims 111,117 is representatively the tubular membrane 180 (see applicants' specification beginning on line 6 of page 14) shown in FIG. 12. The membrane surrounded by piezoelectric material set forth in Claims 115 and 123 is representatively the membrane 180 surrounded by piezoelectric material 182 in FIG. 12. The membrane having fluid flowing therethrough as recited in Claim 118 is representatively the membrane 180 communicating with fluid flow passage 176 (FIG. 12) so that

fluid flowing through the passage 176 must flow through the tubular membrane 180. The cavity surrounding the membrane as recited in Claim 122 is representatively the FIG. 12 cavity 178 surrounding the tubular membrane.

In view of the fact that all of the above claim features set forth by the Examiner are clearly depicted in applicants' drawings as originally filed, the Examiner's objections to applicants' drawings are incorrect and should be withdrawn.

2. THE 37 CFR §1.75(d) AND MPEP §608.01(o) SPECIFICATION OBJECTIONS

The Examiner contends that the fluid chamber as recited in Claim 50 does not have proper antecedent basis in the specification. In this regard the Examiner's attention is respectfully directed to applicants' specification, beginning on line 28 of page 8 thereof, wherein, with reference to FIG. 4, it is stated that "The generator 68 includes a fluid chamber 72 in fluid communication via an opening 74 with a flow passage 76 extending in a fluid conduit 78." In view of this, it is respectfully requested that this objection to applicants' specification be withdrawn.

3. THE 35 USC §112, FIRST PARAGRAPH, REJECTIONS OF CLAIMS 50-73, 111, 115, 117, 118, 122 AND 123

Applicants' specification is clearly seen to adequately describe the claimed subject matter referred to by the Examiner in this rejection. Listed below for the Examiner's convenience are the claimed elements

mentioned by the Examiner and the locations in applicants' originally submitted specification where such elements are described.

(a) "fluid chamber": fluid chamber 72 described beginning on line 28 of page 8 (see FIG. 4);

(b) "tubular membrane": tubular membrane 180 described beginning on line 11 of page 14 (see FIG. 12).

(c) "membrane surrounded by the piezoelectric material": membrane 180 surrounded by the piezoelectric material 182 described beginning on line 16 of page 14 (see FIG. 12).

(d) "fluid flow through the membrane": fluid flow through the tubular membrane 180 (via the flow passage 176 with which it is aligned" is discussed beginning on line 11 of page 14 (see FIG. 12).

(e) "membrane surrounded by the cavity": membrane 180 surrounded by cavity 178 is discussed beginning on line 11 of page 14(see FIG. 12).

All of these claimed features are thus described in applicants' specification and shown in their drawings. It is thus respectfully requested that this rejection of Claims 50-73, 111, 115, 117, 118, 122 and 123 be withdrawn.

**4. THE 35 USC §102(b) REJECTION OF CLAIMS 1-8, 14-19,50, 51,
53, 54, 57, 62, 64, 65, 68-70, 74, 75, 80-82, 86-99, 101 AND 103-106
BASED ON U.S. PATENT 3,970,877 TO RUSSELL ET AL**

Claims 1-8 recite the generation of electricity in response to pressure fluctuations in the conduit. This claimed feature is not disclosed in Russell et al. In Russell et al, electrical power is generated in response to mud flow turbulence external to the illustrated drill string section. Claims 1-8 additionally recite projections formed on the internal surface of the conduit and inducing turbulence in fluid flow in the conduit. Russell et al fails to disclose these claimed turbulence-inducing projections.

Claims 14-19 recite the production of electricity in response to the flexure of a reduced thickness portion of the conduit caused by the flowing of fluid through the conduit. Neither of these claim limitations is disclosed in Russell et al.

Claims 50, 51, 53, 54 and 57 recite that the specified fluid chamber vibrates in response to pressure fluctuations in the fluid conduit, and further recite the production of electricity, in response to fluid chamber vibration, by piezoelectric material attached to the fluid chamber. In Russell et al there is no such fluid chamber which vibrates in response to fluid flow through the conduit.

Claims 62, 64, 65 and 68-70 recite the production of electricity from a piezoelectric material in response to vibrating a chamber in fluid communication with the fluid conduit. As previously mentioned herein, Russell et al does not disclose such a chamber or the vibration thereof to produce electricity.

Claims 74, 75 and 80 recite a member extending into a flow passage and vibrating in response to fluid flow through the fluid conduit. Russell et al is clearly devoid of such a member extending into the conduit flow passage.

Claims 81, 82, 86 and 87 recite the vibration of a member extending into the flow passage in response to the step of flowing fluid through the flow passage. Russell et al fails to disclose such a member or the vibration thereof.

Claims 88-93 recite a member having an orifice formed therethrough, fluid flow through the fluid conduit also flowing through the orifice, and the member vibrating in response to fluid flow through the orifice. It is also recited in these claims that a piezoelectric material is disposed proximate the member, the piezoelectric material producing electricity in response to vibration of the member. None of these claim limitations is disclosed in Russell et al.

Claims 94-97 recite the interconnection in a tubular string a power generator including a member having an orifice formed therethrough, vibrating the orificed member in response to flowing fluid through its orifice, and producing electricity in response to vibrating the orificed member. None of these claim limitations is disclosed in Russell et al.

Claims 98, 99, 101 and 103 recite a member disposed within a fluid conduit, the member displacing within the fluid conduit in response to fluid flow through the fluid conduit, and a retainer preventing displacement of the member out of the fluid conduit. These claimed structural elements are not disclosed in Russell et al.

Claims 104-106 recite the steps of displacing a member within the fluid conduit in response to flowing fluid through the conduit, and producing electricity from a piezoelectric material in response to the member displacing step. These claimed method steps are absent in Russell et al.

In view of the foregoing clear deficiencies in Russell et al, it is respectfully submitted that none of applicants' Claims 1-8, 14-19, 50, 51, 53, 54, 57, 62, 64, 65, 68-70, 74, 75, 80-82, 86-89, 101 and 103-106 is anticipated by the Russell et al reference.

5. THE 35 USC §102(b) REJECTION OF CLAIMS 1-3 AND 8 BASED ON U.S. PATENT 4,467,236 TO KOLM ET AL

Claims 1-3 and 8 recite that the specified fluid conduit has an internal surface having a projection formed thereon which induces turbulence in fluid flow in the conduit. There is no disclosure in Kolm et al of such projections which induce turbulence in fluid flow through the Kolm et al conduit. Accordingly, it is respectfully submitted that none of applicants' Claims 1-3 and 8 is anticipated by the Kolm et al reference.

6. THE 35 USC §102(b) REJECTION OF CLAIMS 1-4, 7, 8, 14, 15, 18 AND 19 BASED ON U.S. PATENT 5,839,508 TO TUBEL ET AL

Claims 1-4, 7 and 8 recite that the specified fluid conduit has an internal surface having a projection formed thereon which induces turbulence in fluid flow in the conduit. There is no disclosure in Tubel et al of such projections which induce turbulence in fluid flow through the

Tubel et al conduit. Accordingly, it is respectfully submitted that none of applicants' Claims 1-4, 7 and 8 is anticipated by the Tubel et al reference.

Claims 14, 15, 18 and 19 recite a reduced thickness portion of the fluid conduit, and the production of electricity in response to flexing of the reduced thickness portion created by the flowing of fluid through the conduit. Tubel fails to disclose any of these claim limitations.

In view of these deficiencies in Tubel et al, it is respectfully submitted that none of applicants' Claims 1-4, 7, 8, 15, 18 and 19 is anticipated by the Tubel et al reference.

**7. THE 35 USC §102(b) REJECTION OF CLAIMS
23, 25, 37, 62, 63, 109, 110, 112-114, 116 AND 119-121
BASED ON U.S. PATENT 5,554,922 TO KUNKEL**

Claims 23 and 25 recite a bias member positioned between a reciprocably disposed mass and piezoelectric material, with pressure fluctuations in the housing causing the mass to displace and thereby induce strain in the piezoelectric material via the bias member. Kunkel fails to disclose these claim limitations.

Claim 37 recites the step of flowing fluid through an outer housing, thereby causing a mass to displace within the housing and induce strain in a piezoelectric material via a bias member positioned between the mass and the piezoelectric material. Kunkel does not disclose a bias member positioned between a mass and piezoelectric material as set forth in these claims.

Claims 62 and 63 set forth the steps of interconnecting a fluid conduit in a tubular string, and positioning the tubular string in a subterranean well. Neither of these steps if disclosed in Kunkel.

Claims 109, 110 and 112-114 recite a cavity separated from a flow passage by a membrane, with the cavity being generally annularly shaped and outwardly surrounding the membrane. Kunkel fails to disclose this claimed relationship between a cavity, flow passage and membrane.

Claims 116 and 119-121 recite the steps of interconnecting a fluid conduit in a tubular string, and positioning the tubular string in a subterranean well. Neither of these steps is disclosed in Kunkel.

Due to the foregoing deficiencies in Kunkel, it is respectfully submitted that none of applicants' Claims 23, 25, 37, 62, 63, 109, 110, 112-114, 116 and 119-121 is anticipated by the Kunkel reference.

**8. THE 35 USC §103(a) REJECTION OF CLAIMS
9-11, 20-22, 59-61 AND 71-73
OVER RUSSELL ET AL OR TUBEL ET AL IN VIEW OF
U.S. PATENT 4,669,068 TO KLATT**

Claims 9-11 recite a turbulence-inducing projection in a fluid flow conduit. Neither Russell et al nor Tubel et al teaches or suggests this claim limitation. This deficiency in the Russell et al and Tubel et al references is in no manner cured by the Klatt reference which has been cited by the Examiner for its teachings with respect to a drill string having a helically shaped fluid conduit.

Claims 20-22 recite the piezoelectric generation of electricity by the flexing of a reduced thickness portion of a fluid flow conduit caused by flowing of fluid through the conduit. Neither Russell et al, Tubel et al or Klatt discloses or in any manner suggests this claimed feature of applicants' invention.

Claims 59-61 recite a fluid chamber in fluid communication with a fluid flow conduit, the chamber vibrating in response to pressure

fluctuations in the fluid conduit, and a piezoelectric material attached to the fluid chamber, the piezoelectric material producing electricity in response to the fluid chamber vibration. None of the Russell et al, Tubel et al and Klatt references teaches or in any manner suggests a fluid chamber having these claimed characteristics.

Claims 71-73 recite the step of vibrating a fluid chamber in fluid communication with a fluid conduit in response to flowing fluid through the fluid conduit, and producing electricity from a piezoelectric material in response to the vibrating step. None of the Russell et al, Tubel et al and Klatt references teaches or in any manner suggests this claimed use of a fluid chamber.

Because of the foregoing deficiencies in the Russell et al, Tubel et al and Klatt references, it is respectfully submitted that Claims 9-11, 20-22, 59-61 and 71-73 are patentably distinguishable over the Russell et al, Tubel et al and Klatt references, whether these three references are taken singly or in any combination thereof.

9. THE 35 USC §103(a) REJECTION OF CLAIMS 12 AND 13 OVER RUSSELL ET AL OR KOLM ET AL OR TUBEL ET AL

Claims 12 and 13 recite a fluid flow conduit having an internal surface having a projection formed thereon which induces turbulence in fluid flow in the conduit. None of the Russell et al, Kolm et al or Tubel et al references discloses or suggests this claim limitation. It is thus respectfully submitted that neither of applicants' Claims 12 and 13 is rendered obvious by any of these three references.

**10. THE 35 USC §103(a) REJECTION OF CLAIMS 111 AND 117
OVER KUNKEL**

Claim 111 recites a membrane separating a fluid conduit flow passage from a cavity in the conduit, the membrane flexing in response to pressure fluctuations in the flow passage, the cavity being generally annularly shaped and outwardly surrounding the membrane. Kunkel clearly fails to disclose or in any manner suggest these claim limitations.

Claim 117 recites the steps of interconnecting a fluid conduit in a tubular string and positioning the tubular string in a subterranean well. These claimed method steps are neither disclosed nor in any manner suggested in the Kunkel references.

Due to the foregoing deficiencies in Kunkel, it is respectfully submitted that neither of applicants' Claims 111 and 117 is rendered obvious by the Kunkel reference.

In view of the foregoing amendment and remarks, all of the claims currently pending in this application are now seen to be in a condition for allowance. A Notice of Allowance of Claims 1-7, 9-15, 18-113 and 115-123 is therefore earnestly solicited.

VERSION WITH MARKINGS TO SHOW CHANGES MADE

Set forth below are Claims 1, 6, 9, 10, 12-14, 19, 74, 81, 109 and 115 which have been appropriately marked to show the changes made therein in the foregoing amendment.

1. (Amended) An electrical power generator for use in conjunction with a subterranean well, the generator comprising:

a fluid conduit configured for flow of fluid therethrough, the fluid conduit having an internal surface having at least a selected one of inwardly and outwardly extending projections formed thereon which induces turbulence in fluid flow in the conduit; and

a piezoelectric material attached to the conduit, the piezoelectric material producing electricity in response to pressure fluctuations in the conduit.

6. (Amended) [The generator according to Claim 5, wherein] An electrical power generator for use in conjunction with a subterranean well, the generator comprising:

a fluid conduit configured for flow of fluid therethrough; and

a piezoelectric material attached to the conduit, the piezoelectric material producing electricity in response to pressure fluctuations in the conduit,

the fluid conduit including a reduced thickness portion thereof, the piezoelectric material being attached proximate the reduced thickness portion,

the reduced thickness portion [has] having an increased degree of flexing, in response to the pressure fluctuations in the conduit, [than does] relative to the remainder of the conduit.

9. (Amended) [The generator according to Claim 1, wherein] An electrical power generator for use in conjunction with a subterranean well, the generator comprising:

a fluid conduit configured for flow of fluid therethrough; and

a piezoelectric material attached to the conduit, the piezoelectric material producing electricity in response to pressure fluctuations in the conduit,

the fluid conduit [is] being helically shaped.

10. (Amended) [The generator according to Claim 1, wherein] An electrical power generator for use in conjunction with a subterranean well, the generator comprising:

a fluid conduit configured for flow of fluid therethrough; and

a piezoelectric material attached to the conduit, the piezoelectric material producing electricity in response to pressure fluctuations in the conduit,

the fluid conduit [has] having a recess internally formed thereon, the recess inducing turbulence in fluid flow through the fluid conduit.

12. (Amended) [The generator according to Claim 1, wherein] An electrical power generator for use in conjunction with a subterranean well, the generator comprising:

a fluid conduit configured for flow of fluid therethrough; and

a piezoelectric material attached to the conduit, the piezoelectric material producing electricity in response to pressure fluctuations in the conduit,

the conduit [is] being made of a titanium material.

13. (Amended) [The generator according to Claim 1, wherein] An electrical power generator for use in conjunction with a subterranean well, the generator comprising:

a fluid conduit configured for flow of fluid therethrough; and
a piezoelectric material attached to the conduit, the piezoelectric material producing electricity in response to pressure fluctuations in the conduit,

the conduit [is] being made of a composite material.

14. (Amended) A method of producing power in a subterranean well, the method comprising the steps of:

attaching a piezoelectric material to a reduced thickness portion of a fluid conduit;

interconnecting the fluid conduit in a tubular string;

positioning the tubular string in the well; and

flowing fluid through the fluid conduit, the piezoelectric material producing electricity in response to flexing of the reduced thickness portion created by the flowing of fluid through the conduit,

the reduced thickness portion having an increased degree of flexing, in response to the pressure fluctuations in the conduit, relative to the remainder of the conduit.

19. (Amended) [The method according to Claim 18, wherein] A method of producing power in a subterranean well, the method comprising the steps of:

attaching a piezoelectric material to a fluid conduit;

interconnecting the fluid conduit in a tubular string;

positioning the tubular string in the well; and

flowing fluid through the fluid conduit, the piezoelectric material producing electricity in response to the flowing of fluid through the conduit,

the flowing step further comprising inducing turbulence in the fluid flowing through the fluid conduit, the inducing turbulence step further [comprises] comprising shaping the fluid conduit in a manner increasing turbulence in the fluid flowing through the fluid conduit.

74. (Amended) An electrical power generator for use in conjunction with a subterranean well, the generator comprising:

a fluid conduit having [a] an internal flow passage for flow of fluid therethrough;

a member extending into the flow passage, the member vibrating in response to fluid flow through the fluid conduit; and

a piezoelectric material producing electricity in response to vibration of the member.

81. (Amended) A method of producing power in a subterranean well, the method comprising the steps of:

interconnecting in a tubular string a fluid conduit having [a] an internal flow passage;

positioning the tubular string in the subterranean well;

flowing fluid through the flow passage;

vibrating a member extending into the flow passage in response to the flowing fluid step; and

producing electricity from a piezoelectric material in response to the member vibrating step.

109. (Amended) An electrical power generator for use in conjunction with a subterranean well, the generator comprising:

a fluid conduit having a flow passage formed therethrough and a cavity;;

a membrane separating the flow passage from the cavity, the membrane flexing in response to pressure fluctuations in the flow passage, the cavity being generally annularly shaped and outwardly surrounding the membrane; and

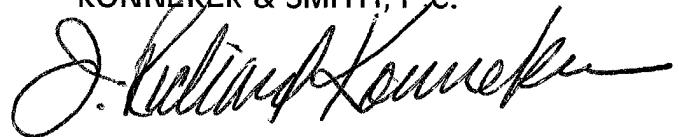
a piezoelectric material disposed within the cavity, the piezoelectric material producing electricity in response to the membrane flexing.

115. (Amended) The generator according to Claim [114] 109, wherein the piezoelectric material is generally annular shaped and outwardly surrounds the membrane.

The Examiner is hereby requested to telephone the undersigned attorney of record at 972/516-0030 if such would further or expedite the prosecution of the instant application.

Respectfully submitted,

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